Distributed Data Mining for Aircraft Health Management

Mitek Analytics LLC

Technical Abstract

Aircraft Flight Operations Quality Assurance (FOQA) programs are implemented by most of the aircraft operators. Vast amounts of FOQA data are distributed between many computers, organizations, and geographic locations. This project develops methodology for transforming such distributed data into actionable knowledge in application to aircraft health management from the vehicle level to the fleet level to the national level. The distributed data processing methodology provably obtains the same results as would be obtained if the data could be centralized. The data mining methods are efficient and scalable so that they can return results quickly for 10Tb of distributed data. This data mining technology that we call Distributed Fleet Monitoring (DFM) developed in SBIR Phase I satisfies these requirements. The data are transformed into models, trends, and anomalies. The model training and anomaly monitoring are formulated as convex optimization and decision problems. The optimization agents are distributed over networked computers and are integrated through remote connection interface in a scalable open grid computing framework. Though the data and the computations are distributed, they yield provably the same optimal solution that would be obtained by a centralized optimization. DFM feasibility was demonstrated in the problem of monitoring aircraft flight performance from fleet data using large realistic simulated datasets. We demonstrated efficient computation of quadratic optimal solution by interacting distributed agents. The feasibility demonstration successfully recovered aircraft performance anomalies that are well below the level of the natural variation in the data and are not directly visible. The algorithms are very efficient and scalable. Phase I demonstration extrapolates to processing 10Tb of raw FOQA data in under an hour to detect anomalous units, abnormal flights, and compute predictive trends.

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2010 Phase II
Proposal A1.15-8747

A High Order Accuracy Computational Tool for Unsteady Turbulent Flows and Acoustics

Frendi Research Corporation

Technical Abstract

Accurate simulations of unsteady turbulent flows for aerodynamics applications, such as accurate computation of heat loads on space vehicles as well the interactions between fluids and structures is of utmost importance to the aerospace industry and NASA. Using a Finite Element Framework suited for both fluids and structures, we propose to continue building on the successes of Phase I by adding various turbulence solution methodologies as well additional multi-disciplinary physics to address complex problems with complex geometries, while maintaining high order accuracy of the framework.

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2010 Phase II
Proposal A2.06-8769